FIG. la

FIG. lb

O ——⊗————————⊗ F

FIG. lc

FIG. ld

FIG. le

O1 ⊗
          F
O2 ⊗

FIG. lf

F1
O ⊗
          F2

FIG. lg

FIG. lh

FIG. 2A

FIG. 2B

22

FIG. 2C

FIG. 2D

26   24

FIG. 3a

O

F

FIG. 3b

FIG. 3c

O

F

FIG. 3d

FIG. 3C

34

32

FIG. 3D

FIG. 4A

FIG. 4B

FIG. 5

54

52

56

FIG. 7

74

72

74

FIG. 6a

62

62'

64

FIG. 6b

FIG. 6c

FIG. 8

Mixed Phase

→ Form Complex
on Bead

→ Post form
Array

→ Form Complex
on Planar Surface

Solid Phase
(Pre-form Array)

Liquid Phase

→ Form Complex
in Solution

← Capture Complex

LEGEND

P— PROBE
T— TARGET
PT— P-T COMPLEX

FIG. 9a

Flow along Conduit →

Transverse Flow →

92

FIG. 9b

Illuminated Zone

FIG. 9c

FIG. 10

104

102

104

106

104

102

110

110

112

108

FIG. IIa

FIG. IIb

Local fluid velocity

FIG. IIc

Light   Light induced
               flow field

FIG. IId
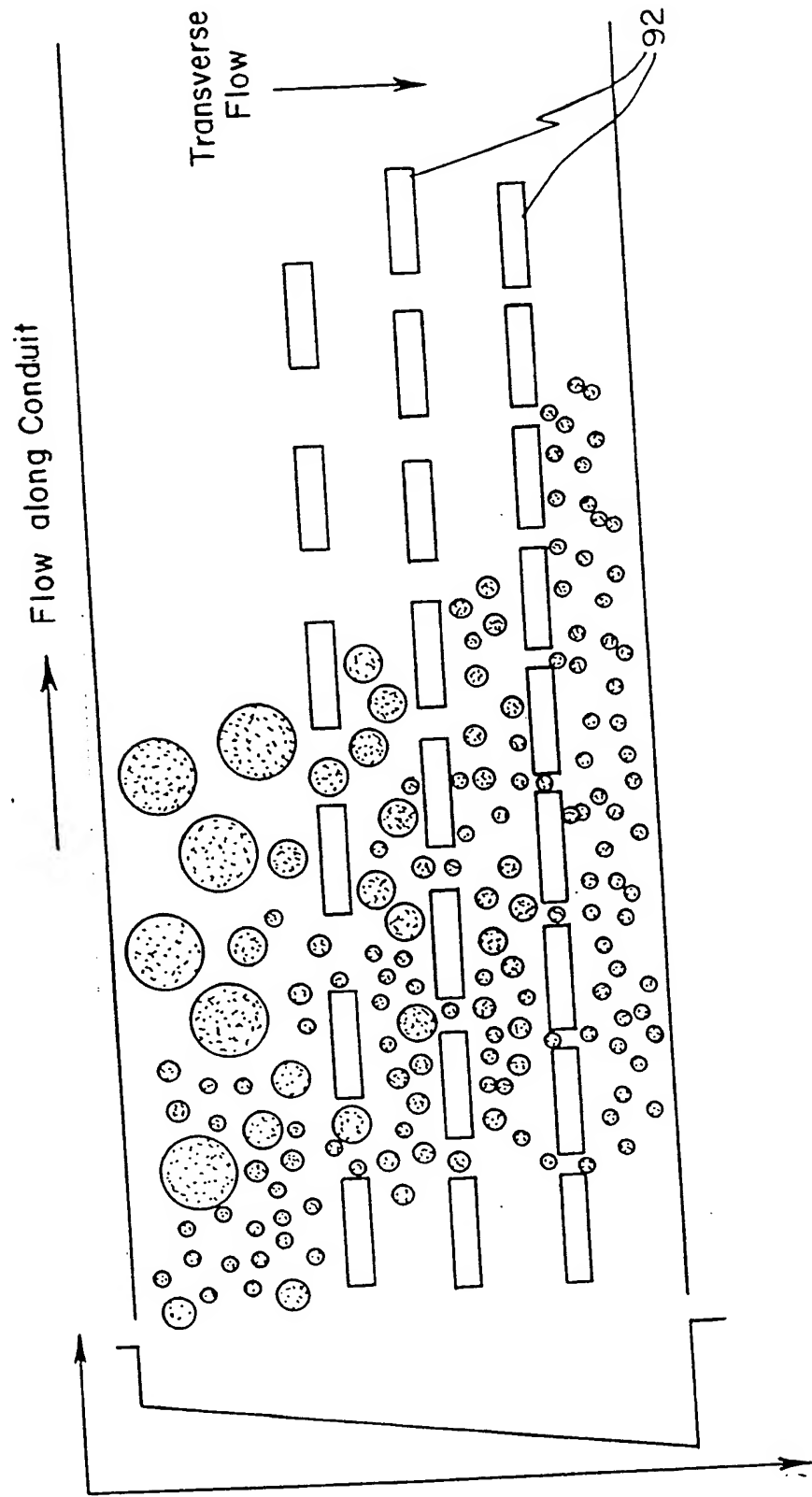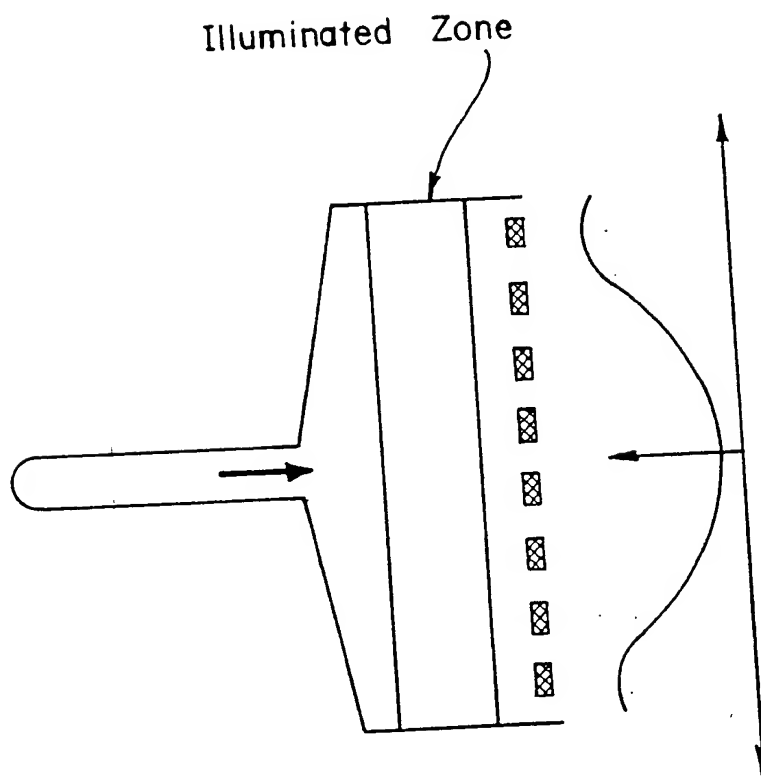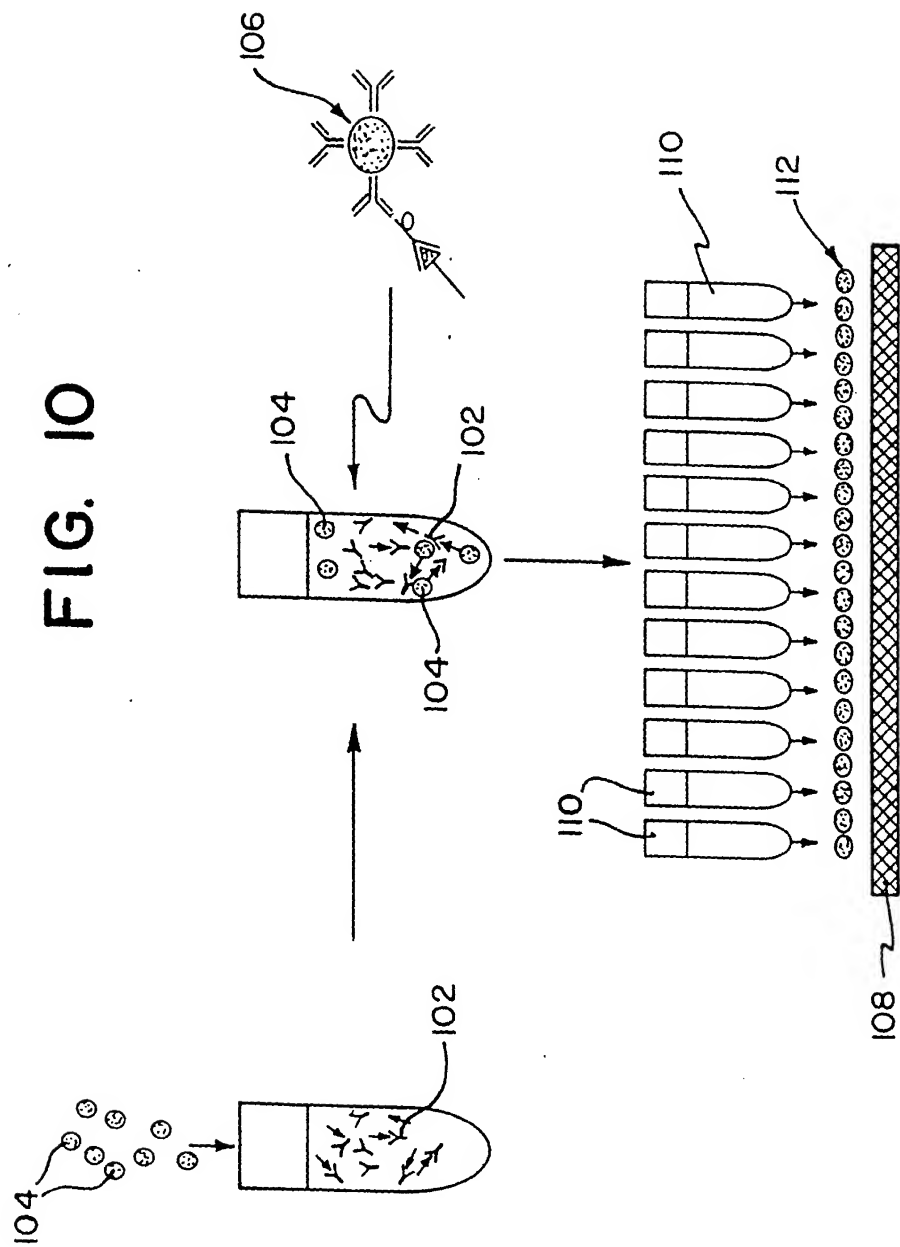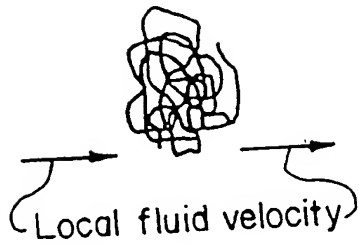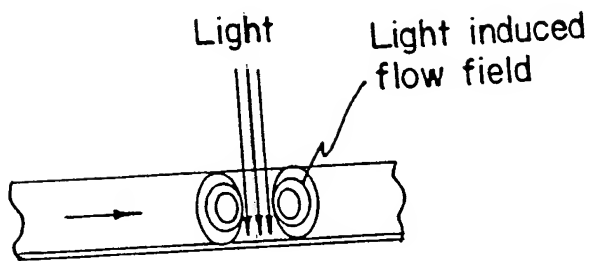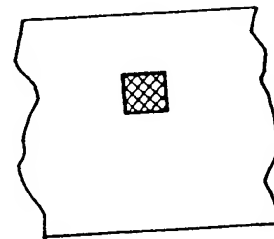
FIG. IIe
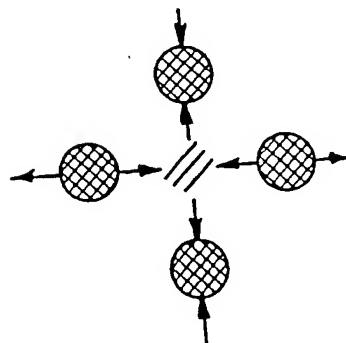
ILLUMINATION PATTERN GENERATOR

Observation
Camera

LCD

Light
Source

VGA

Application
Software

PC

Illumination
Pattern

Projected
Illumination
Pattern
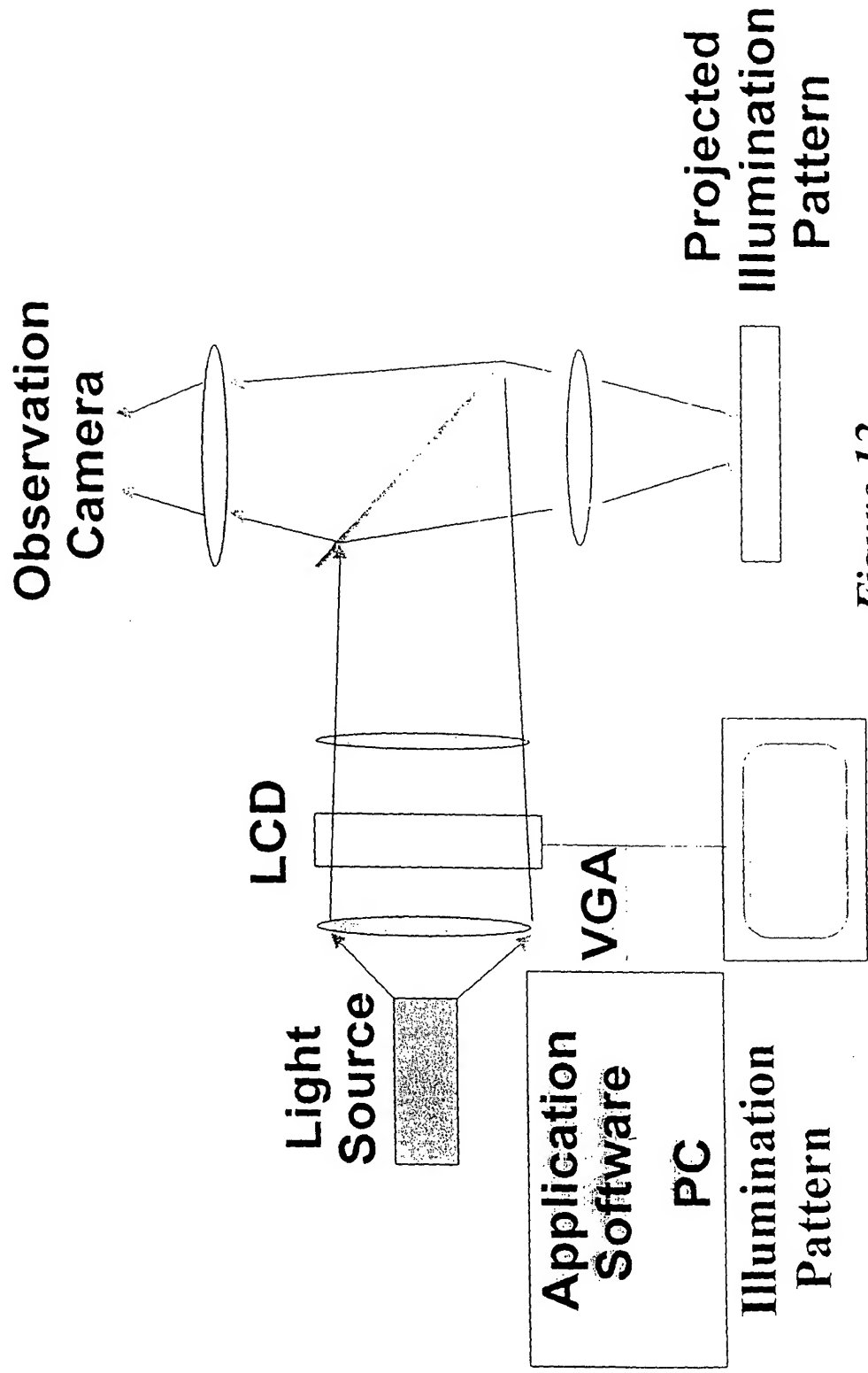
Figure 12

LCD-PARSE OPTICAL DESIGN
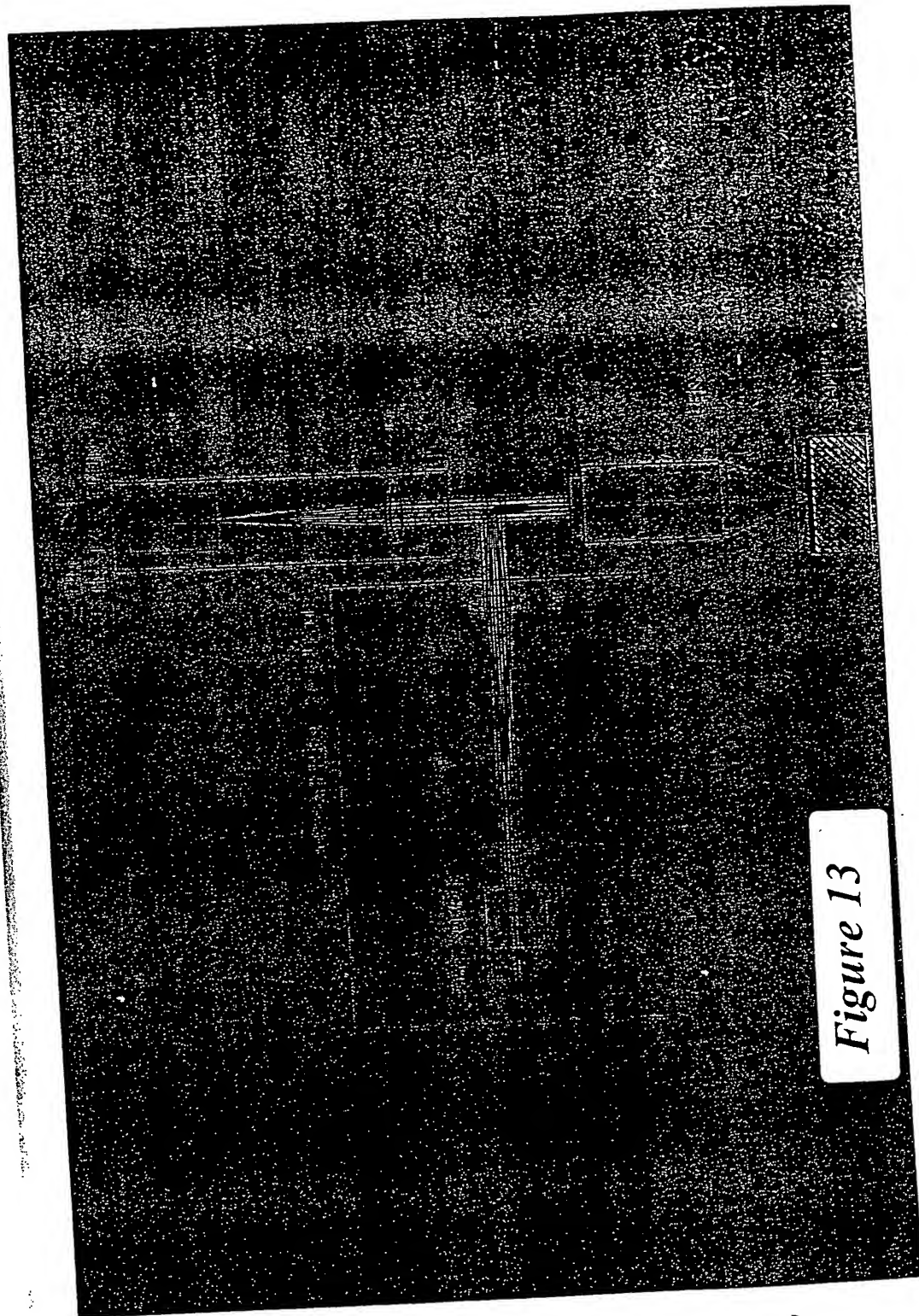
Figure 13

ARRAY SHAPE ADJUSTMENTS

CIRCLE

HORIZONTAL LINE

Figure 14a

Figure 14c

VERTICAL LINE

SQUARE

Figure 14b

Figure 14d

COLLECTION AND ARRAY ASSEMBLY

CollectedParticles

14_05_99 16-53-13.hmp2.2um bead attract to lighted area at 10KhZ, 10VP-P, 1V off,0.2A Laser
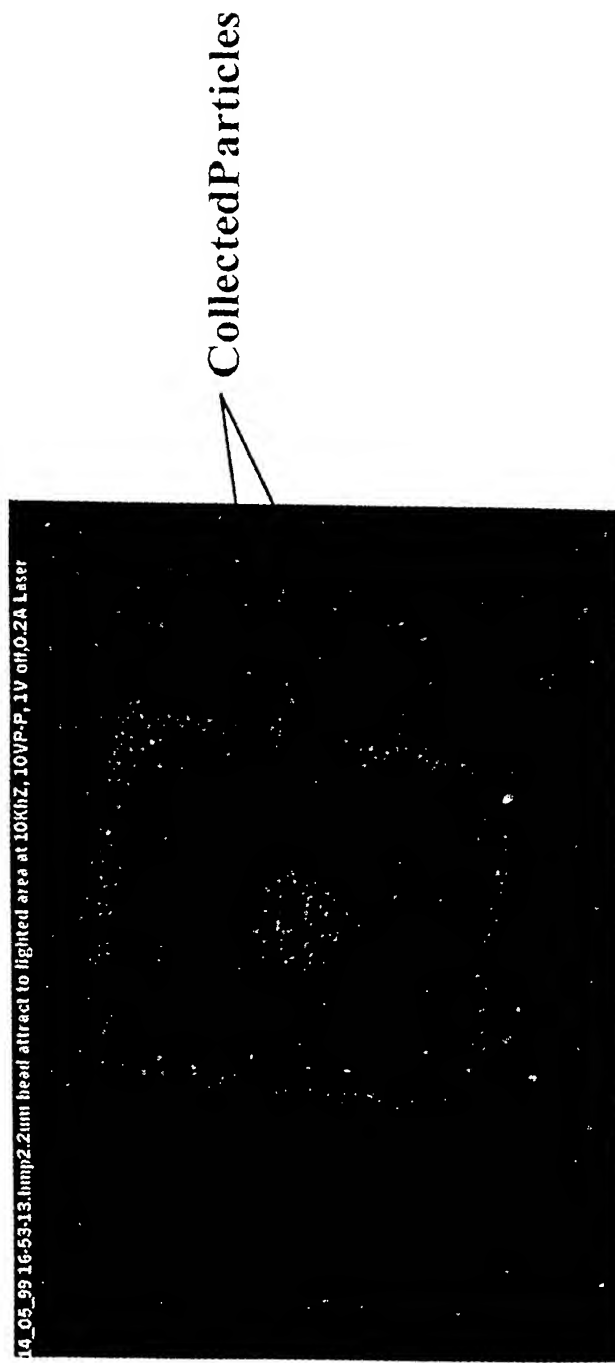
Figure 15a

EXPULSION AND CONFINEMENT

Confined Particles

Illuminated Regions

"Ghost" Image

14_05_99 16-54-05.hmp2.2um bead Rejected from lighted area at 10KHz, 10VP-P, 1V off,0.25 A Laser
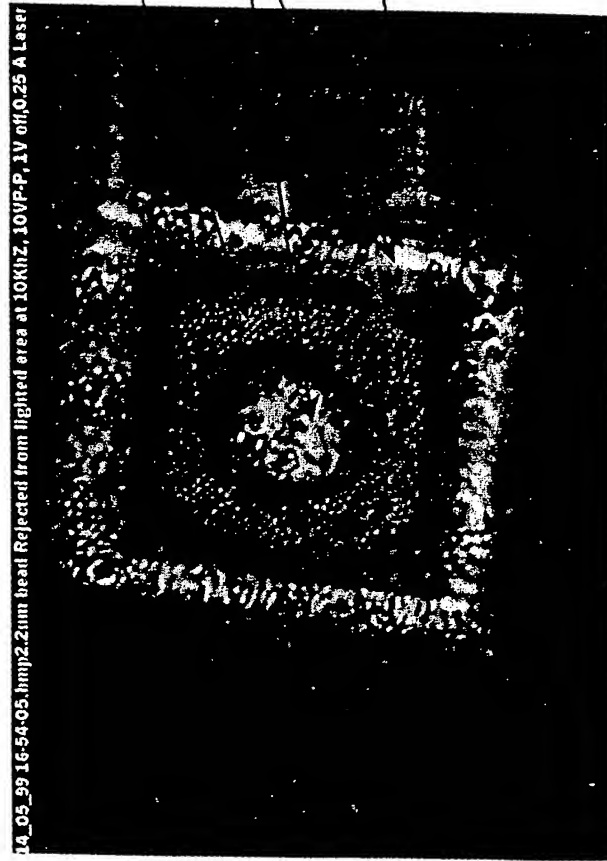
Figure 15b

DRAG AND DROP
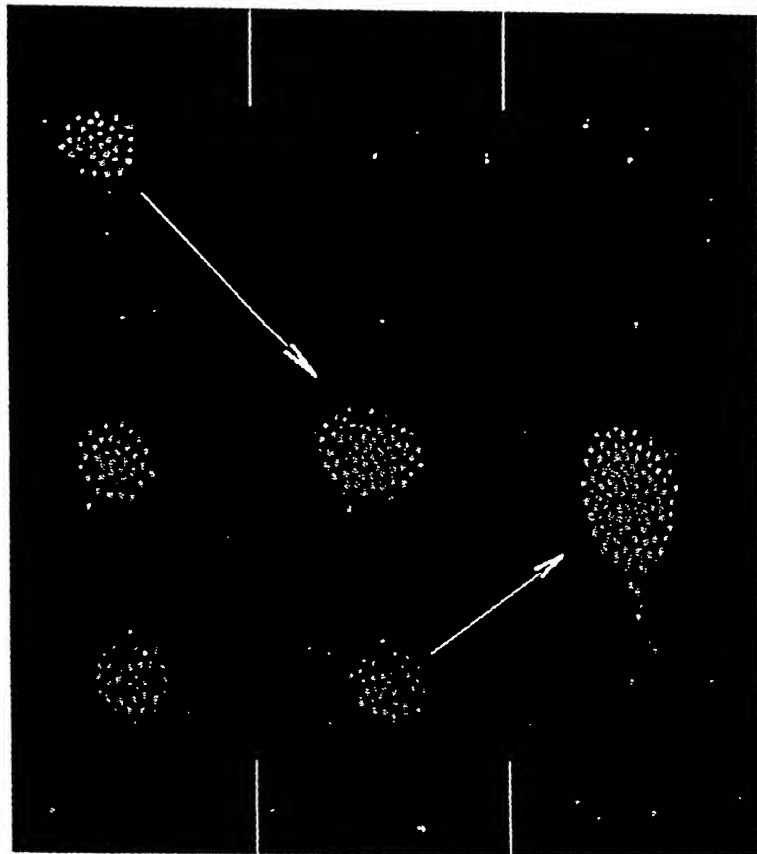
Figure 16

Programmable Array Reconfiguration and Segmentation

Dynamic Bead Array
with Labeled Subarray

Illumination of
Subarray Boundary

Array Segmentation

Illumination Profile
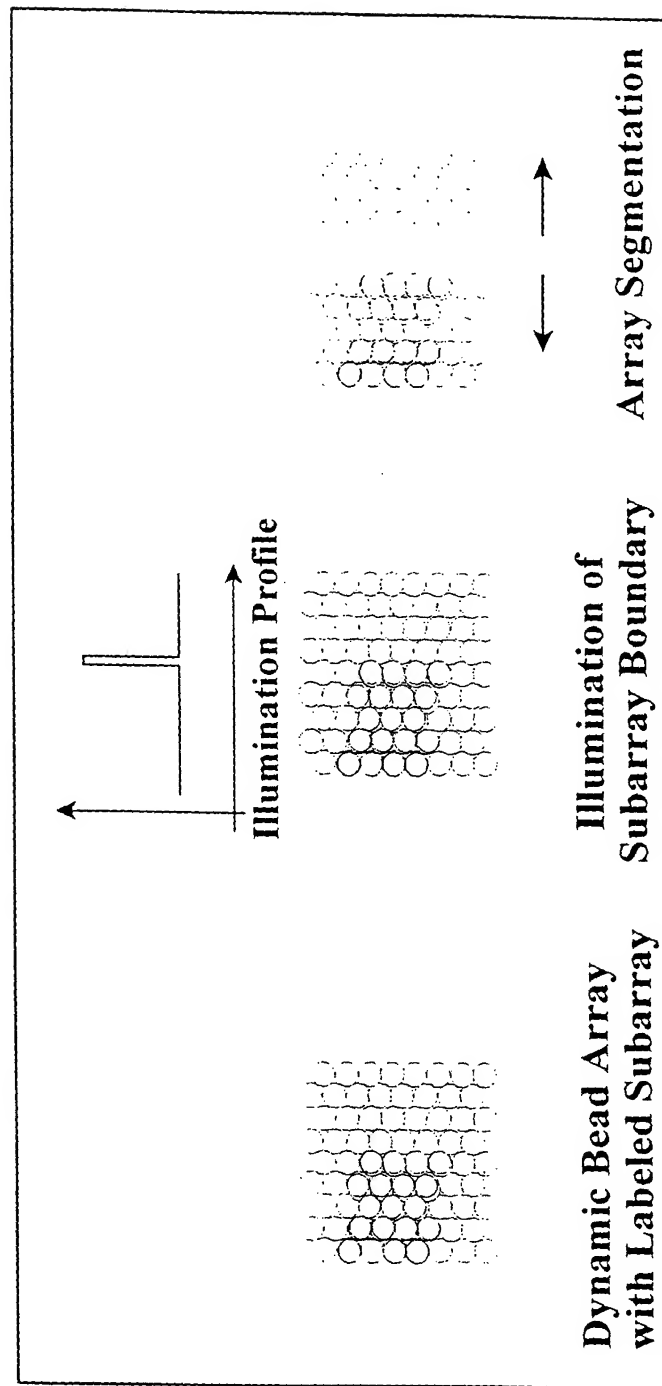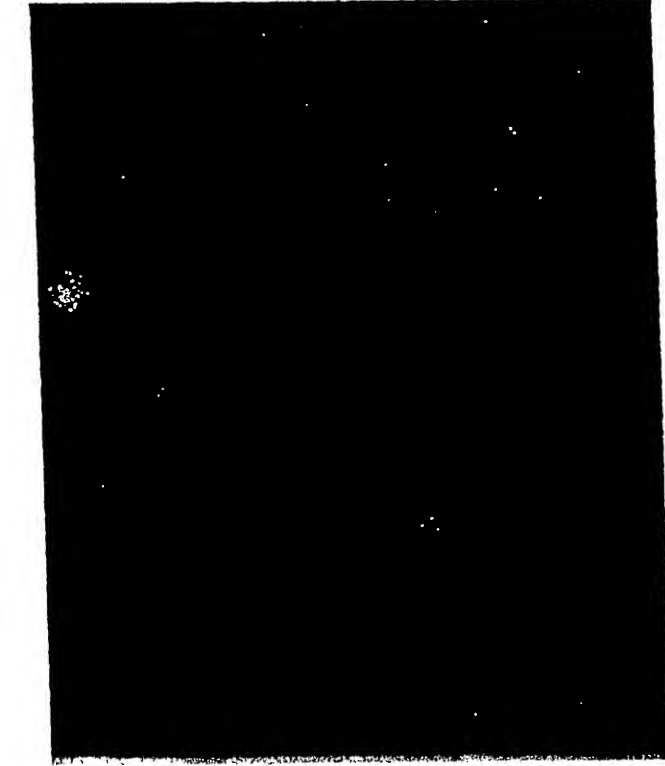
Figure 17

LCD PARSE

Figure 18a
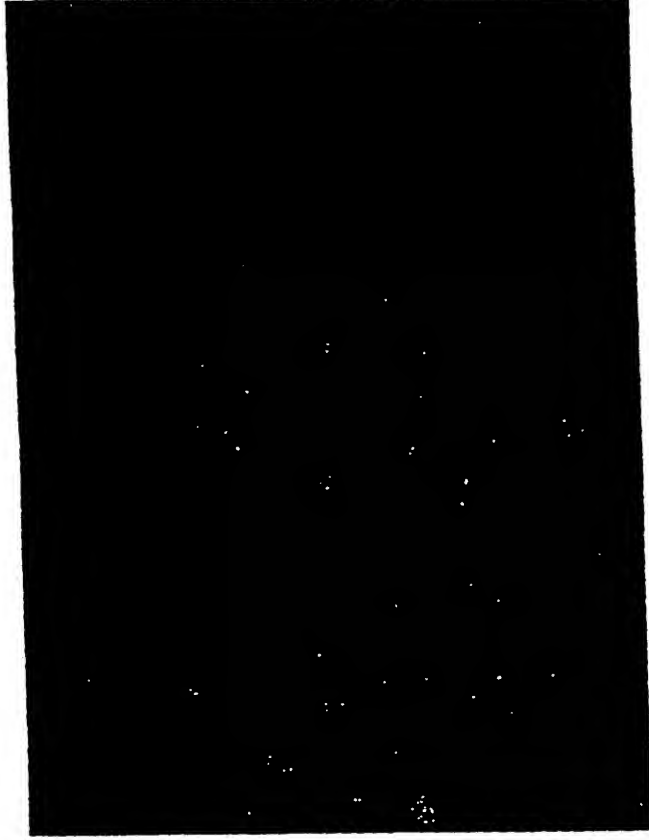
Figure 18b

LCD PARSE

Figure 19

FRACTIONATION

Differential Frequency Dependence of Particle Expulsion
(NOTE: ω_c denotes a characeristic frequency)

Single Particle (Type 1)

Mixture (Types 1, 2)

Particle Type 1

Particle Type 2

Particle Collection and Array Assembly
$\omega < \omega\_c$

Particle Expulsion
$\omega\_c < \omega$

Differential Expulsion
$\omega\_c (1) < \omega < \omega\_c (2)$
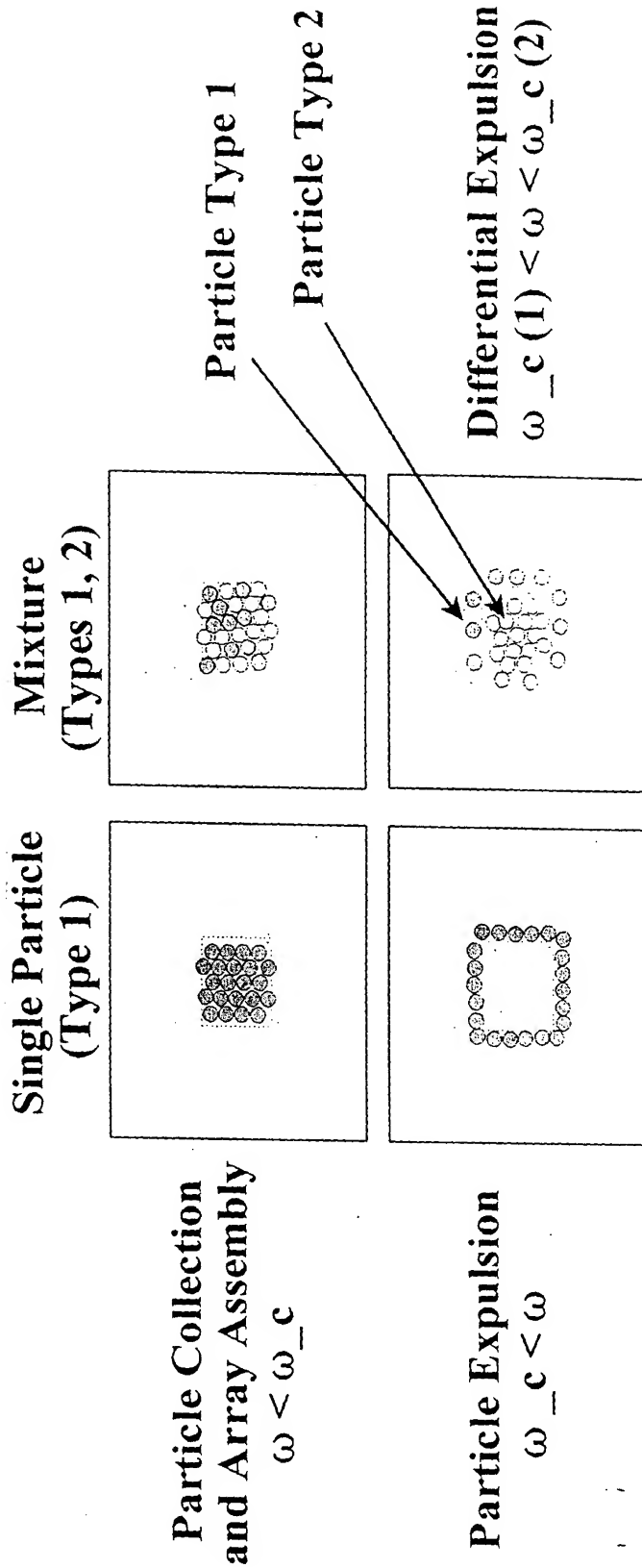
ω_c (Type 1) $< \omega\_c$ (Type 2)

Figure 20a

FRACTIONATION
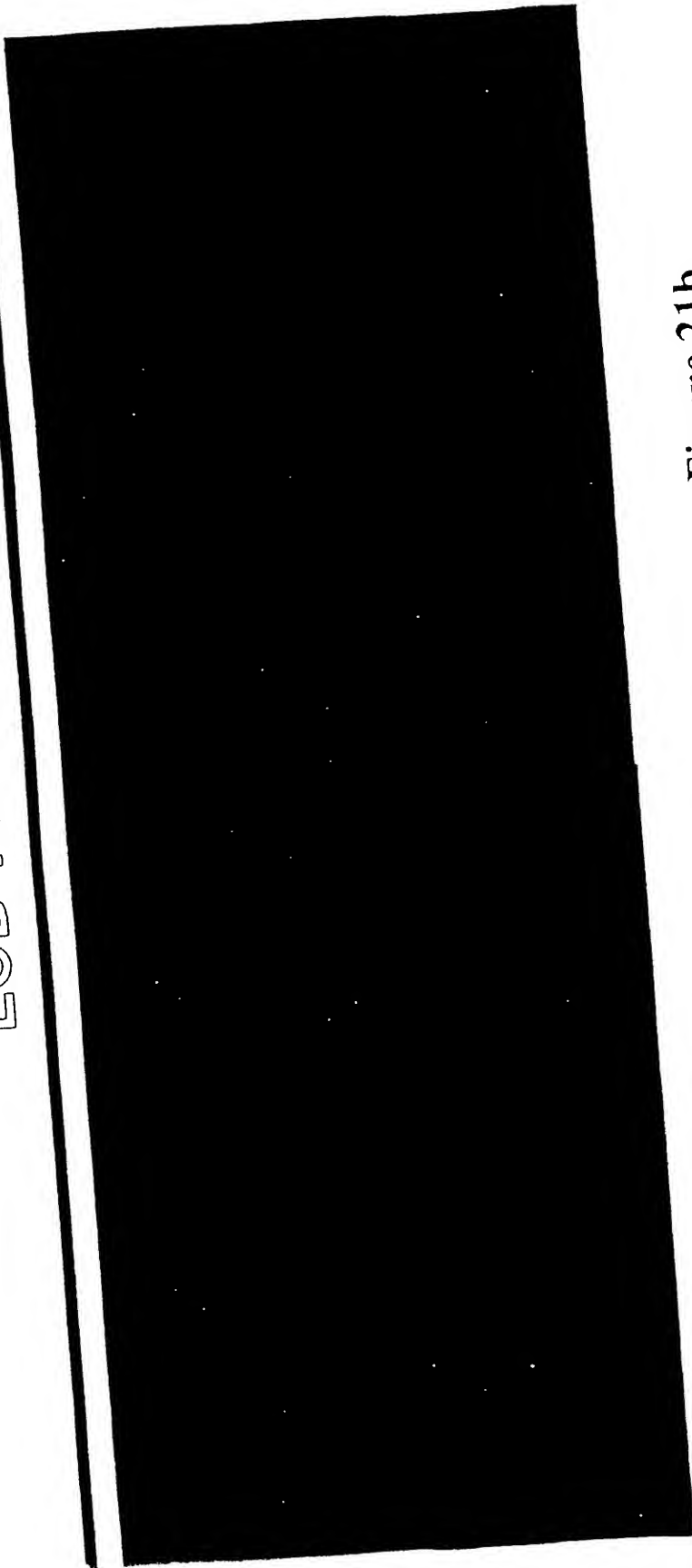
Illuminated Region

Small particles collected in illuminated rgion

Large particles expelled from illuminated rgion

Figure 20b

LCD PARSE

Figure 21b

Figure 21a

Single Step Carrier Coding
- Optical
  - bulk staining (1-100)
  - "stacking"
  - Dielectric (1-6)

Multiple Step Reaction Coding
- Optical
  - Surface labeling (2^n)

A. CHEMICAL ENCODING

Multi-Site:
Droplet Array Deposition

Multi-Step:
Random Sequential Injection

B. SPATIAL ENCODING

1 - Pre-Processing

Figure 22a

2 - Post-Processing

Selective
Anchoring
("Painting")
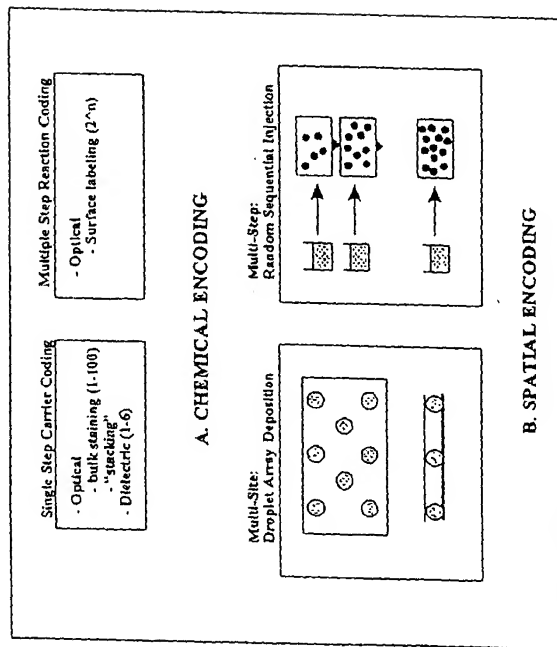
Array
Segmentation
(PARSE)

Dielectric
Sorting
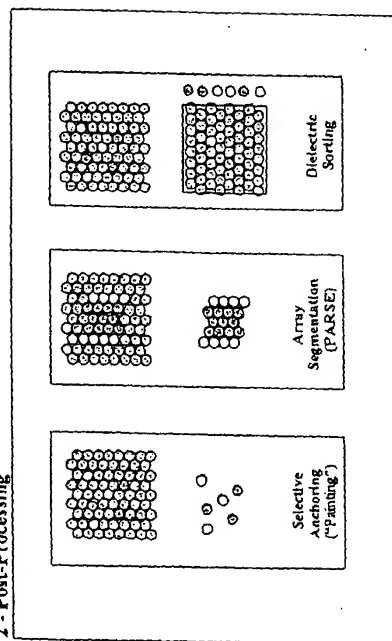
Figure 22b

RANDOM SEQUENTIAL INJECTION

Image 1:Im_1

Im_2

Im_3

Im_n

Injection 1

Injection 2

Injection 3

Injection n

Reservoir 1

Reservoir 2

Reservoir 3

Reservoir n

Top View
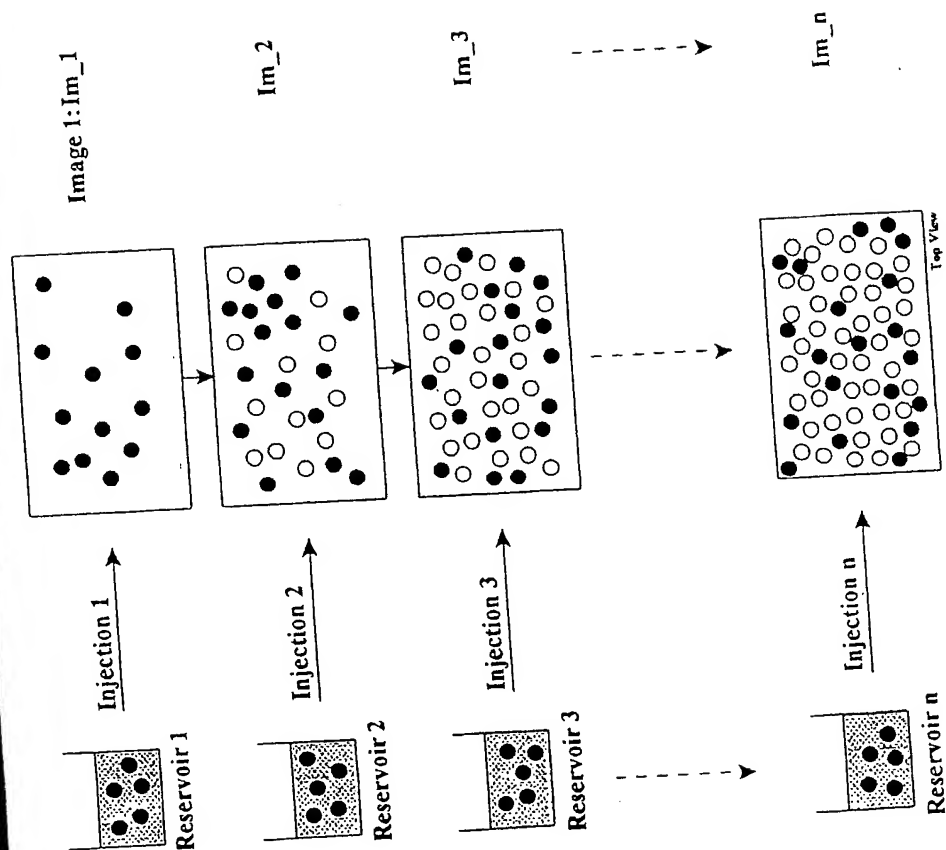
Figure 23

SEQUENTIAL INJECTION &
LIGHT-CONTROLLED ARRAY PLACEMENT

Image 1 : Im_1

Im_2

Im_3

Injection 1

Reservoir 1

Injection 2

Reservoir 2

Injection 3

Reservoir 3

Injection n

Reservoir n
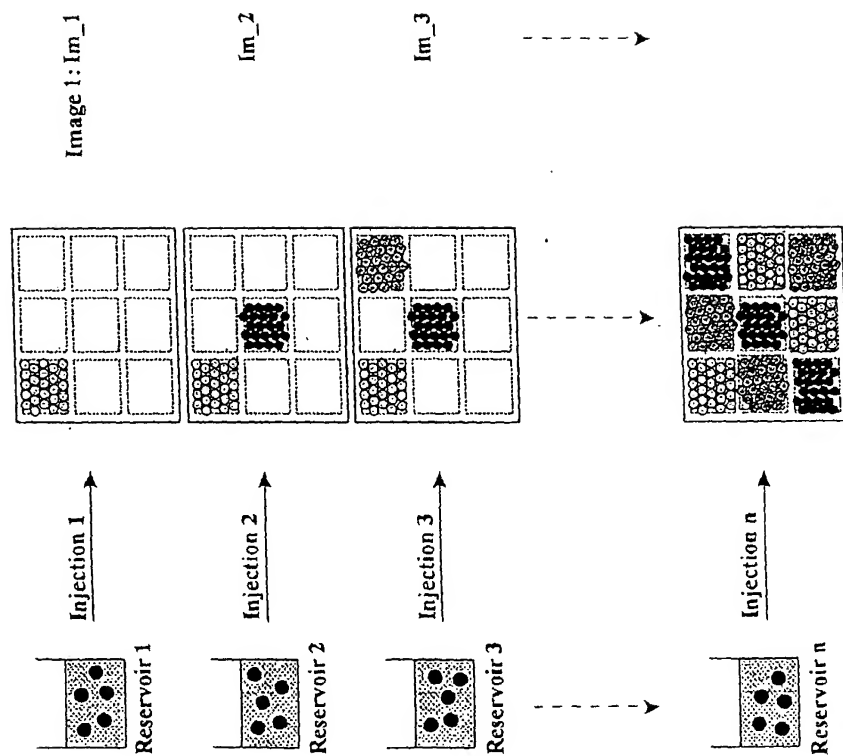
Figure 24

MACRO-TO-MICRO TANSITION

WELLS

CHIP

BEAD ARRAYS
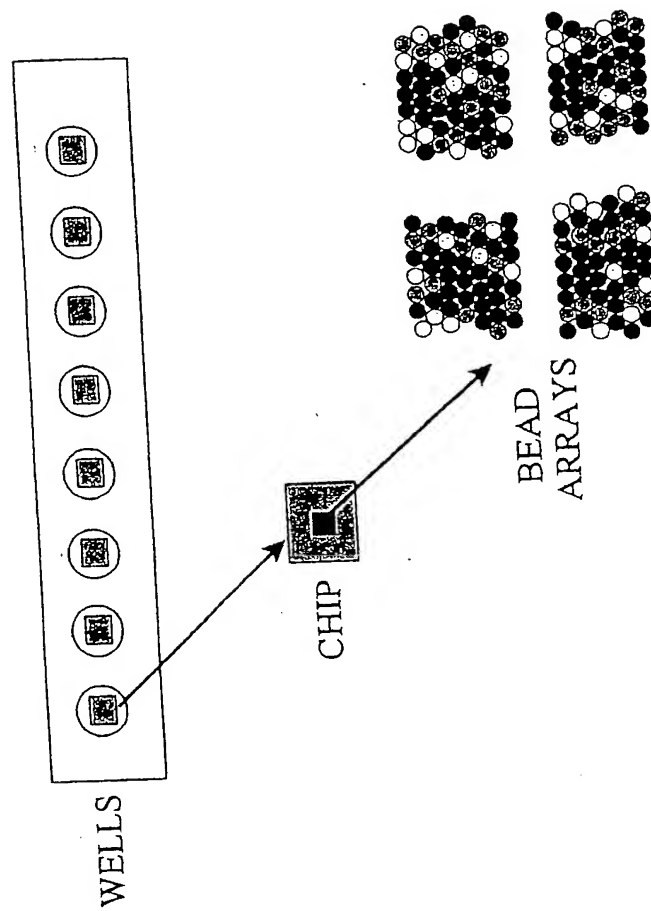
Figure 25a

ARRAY ENCODING
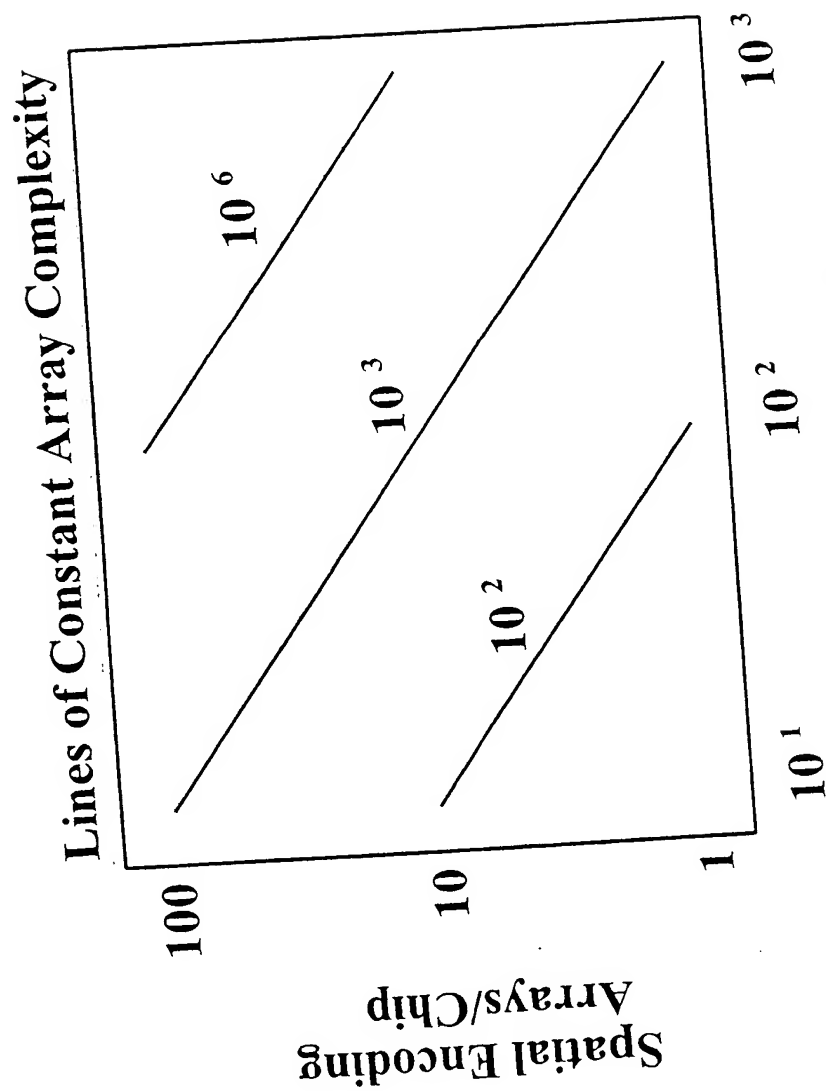
Figure 25b

ARRAY ENCODING

r1 r2 r3 r4

Reservoirs

r5 r6 r7 r8

Reservoirs

Chip With
Multiple
Bead Arrays

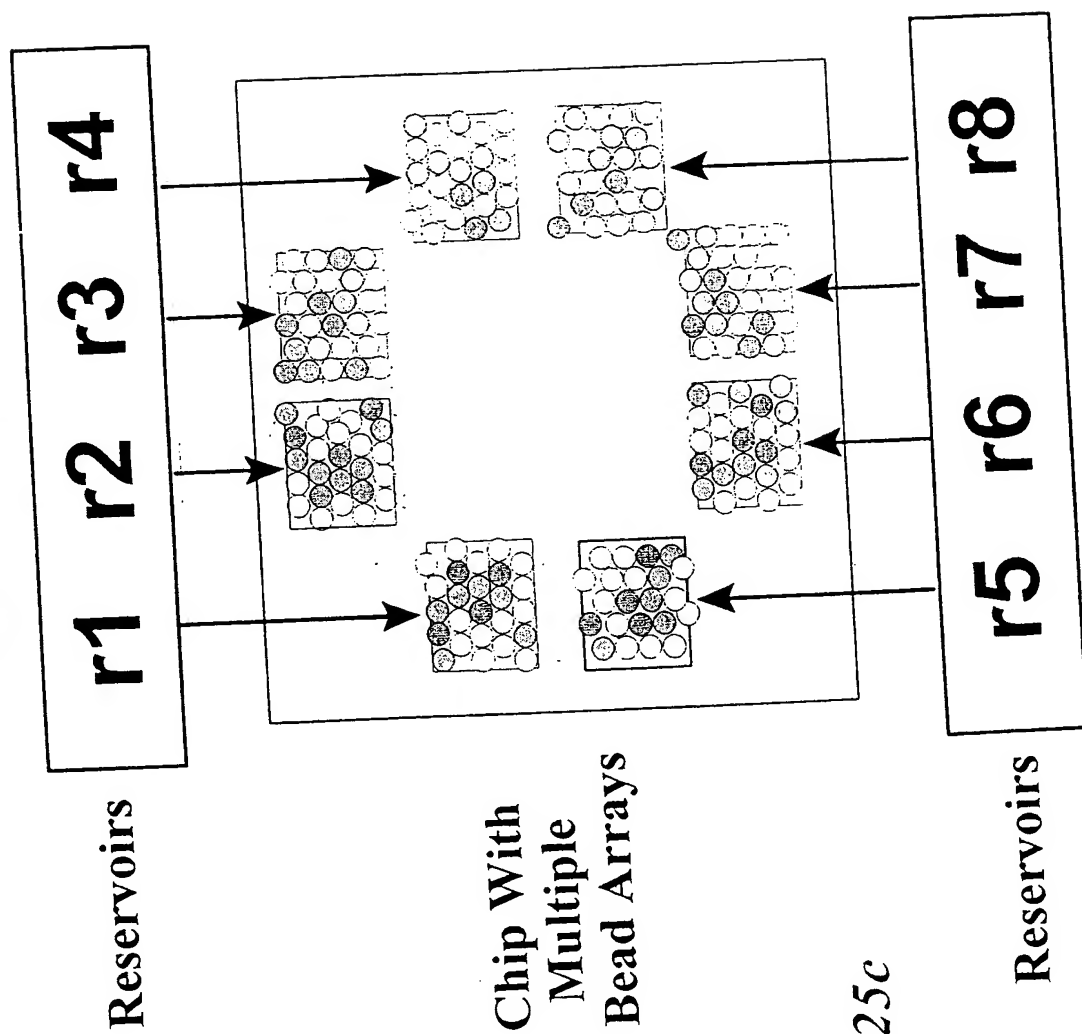Figure 25c

SEQUENTIAL ASSEMBLY: "BANDING"

A B C D
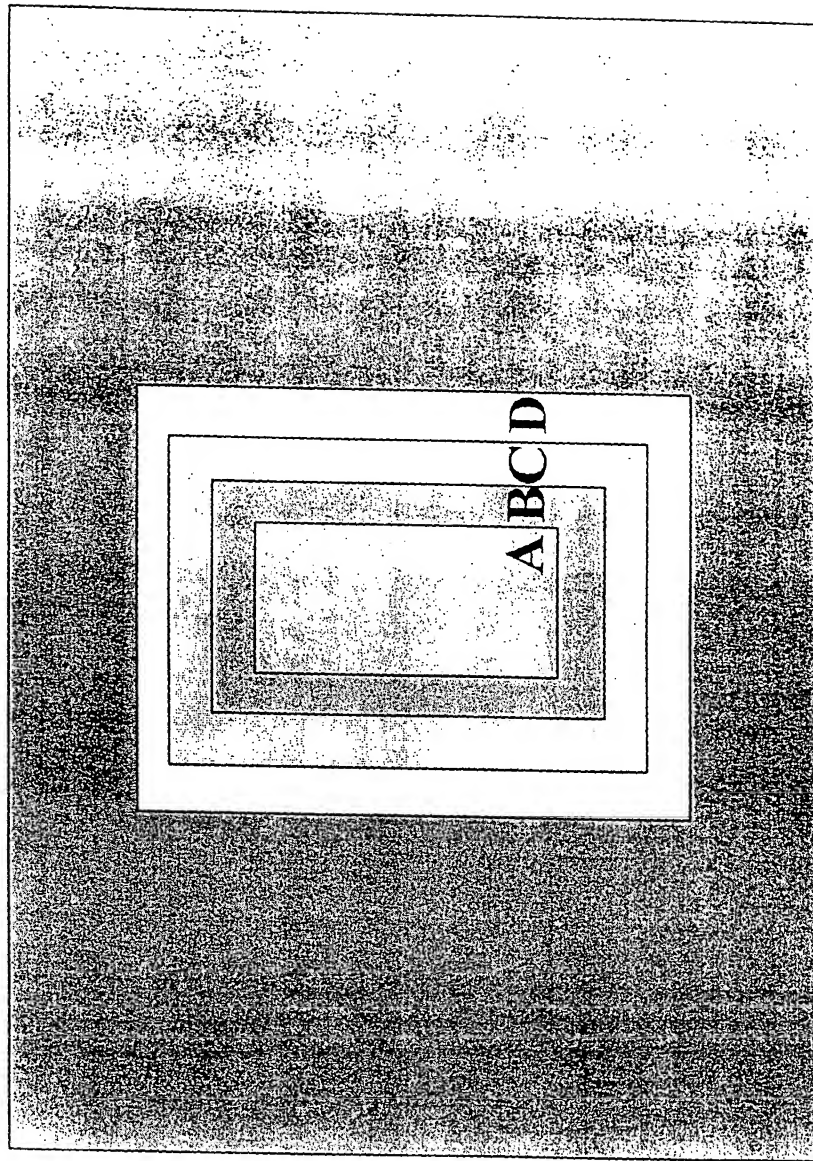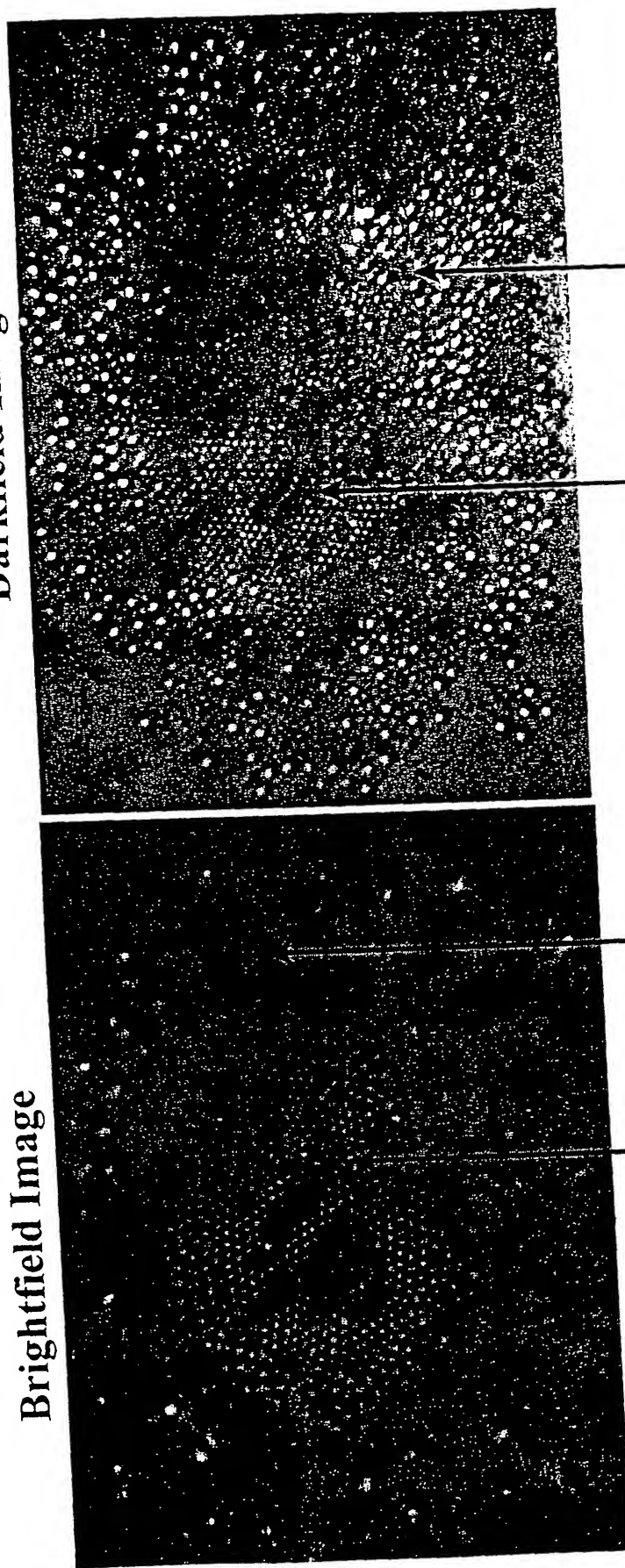
Figure 26a

SEQUENTIAL ASSEMBLY: "BANDING"

Mixture of Two Particle Types

Brightfield Image

Darkfield Image

2.8 μm   5.5 μm

2.8 μm   5.5 μm

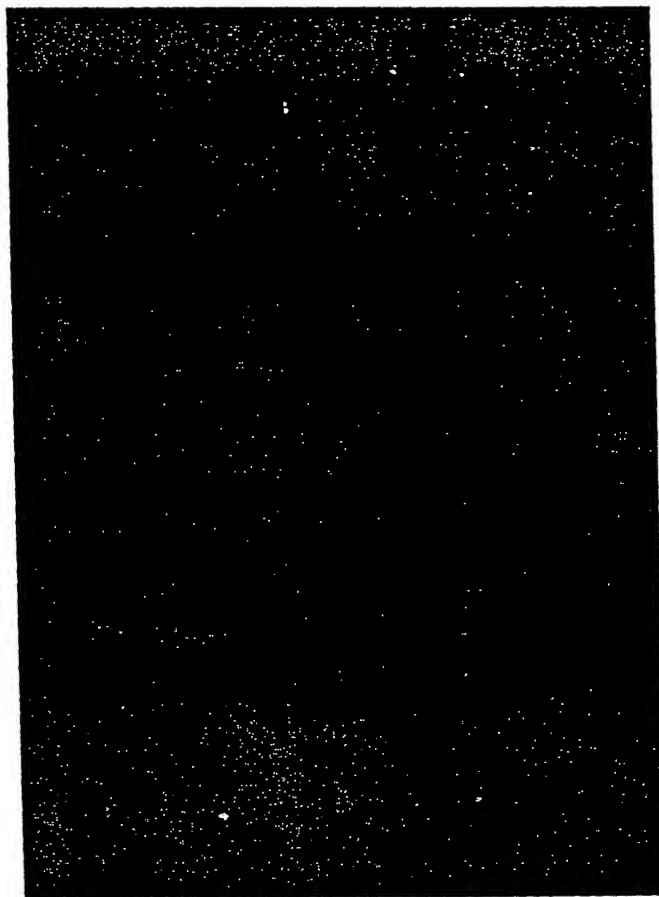*Figure 26b*

LCD PARSE

Figure 27
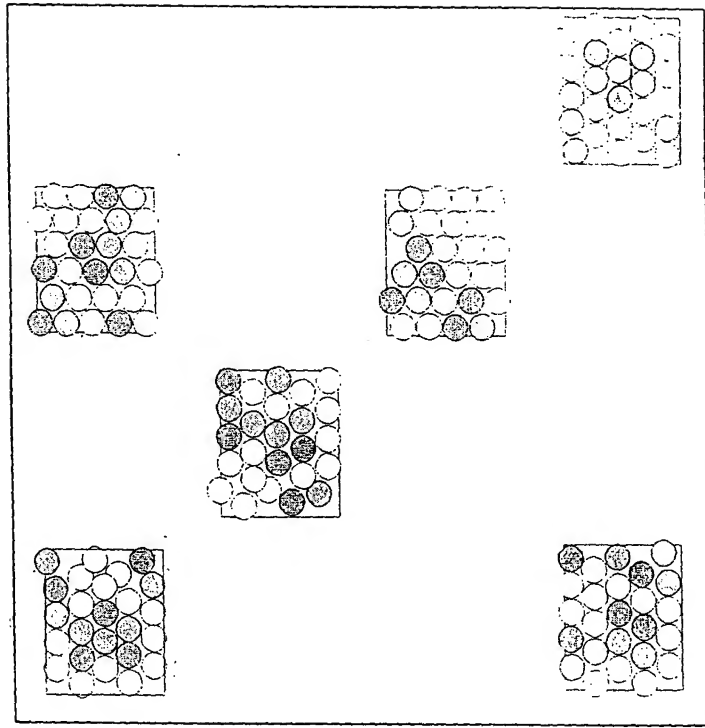
ARRAY OF RANDOM SUBARRAYS

A UNIQUE TWO-DIMENENSIONAL BAR CODE
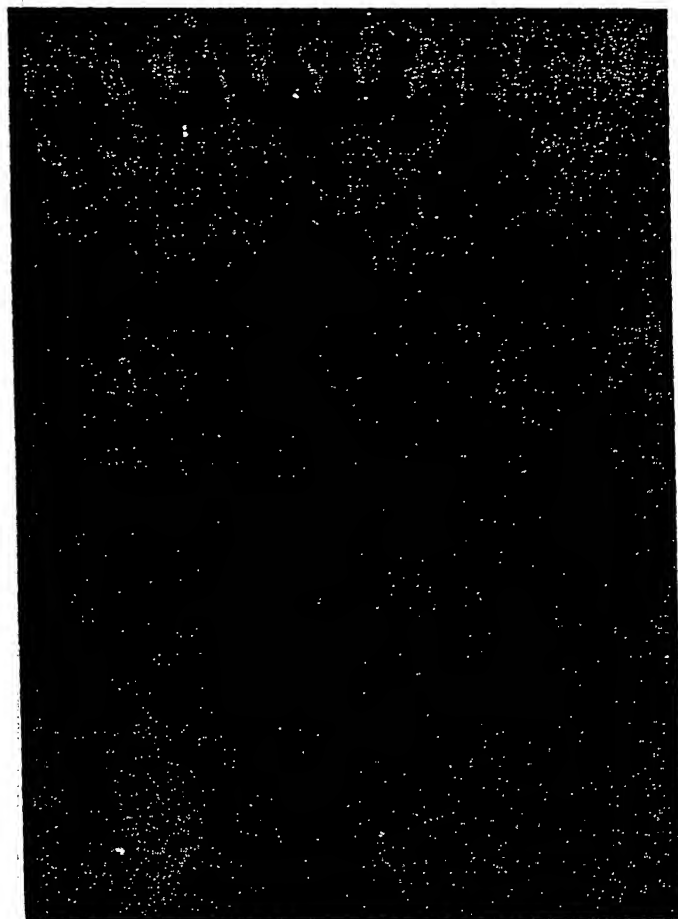

Figure 28

LIGHT-INDUCED FLUID FLOW

Figure 29